Staff Paper

Alternatives to Methyl Bromide in Michigan Field Production of Seedling Conifers and Herbaceous Perennials – Economic Comparisons

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Introduction

According to the 2004-2005 Michigan Rotational survey[1], 2,970 acres of herbaceous perennials and 11,500 acres of narrow leaved evergreens (from here on referred to as conifers) were grown commercially in Michigan during 2004. This represents a 52 percent increase in herbaceous perennial acreage and a four percent increase in conifer acreage compared to values reported in the 1999-2000 Michigan Rotational survey (Table 1).

Table 1. Nurseries: acres herbaceous plants and conifers, 1999, 2004

Category	1999	2004
Daylillies	370	365
Hosta	235	260
Ornamental grasses	60	105
Other herbaceous perennials	1,080	1,420
Vines and ground covers	110	70
Bulbs, corms and rhizomes	90	740
Water garden (aquatic) plants	5	10
All herbaceous plants	**1,950**	**2,970**
Conifers	**11,000**	**11,500**

Michigan Rotational Survey, 1999, 2004/5. USDA- NASS

The leading five counties for nursery production in Michigan during 2004 were, respectively, Ottawa, Allegan, Washtenaw, Berrien, and Oakland (MDA, 2005). Though limited in acreage, the herbaceous perennial industry in Michigan produced sales of about $105 million in 2004/5. The conifer seedling industry in Michigan continues to be important.

[1] Unless otherwise noted, information in the introductory section is taken from the Michigan Rotational Survey, Nursery and Christmas Tree Inventory, 1999 & 2004/5.

In 2004/5, sales of all woody plants through wholesale and retail outlets was nearly $125 million in Michigan (MDA, 2005).

During the 1990's, methyl bromide was a fairly common soil fumigant in nursery production in Michigan for herbaceous perennials and conifer seedlings. In 2000, 12 percent of Michigan nursery growers reported using methyl bromide (Carpenter et. al., 2000). By this time, methyl bromide was part of a planned phase-out of ozone-depleting compounds regulated by the US Environmental Protection Agency (EPA, 2007b). In 2005 the EPA phased out the use of methyl bromide except for critical-use exemptions and pre-shipment and quarantine uses (EPA, 2007b). In 2007, Michigan growers were granted critical use exemptions (CUE) for use of methyl bromide in production of cucurbits, eggplants, peppers, tomatoes, conifer seedlings and herbaceous perennials (EPA, 2007a). CUE's are granted to industries in which alternatives to the use of methyl bromide are not technically or economically feasible and are evaluated through an extensive application and review process (EPA, 2007b).

Research questions and partial budgets

This project provides an economic comparison of alternatives to methyl bromide use in the control of soil borne plant pathogens and weeds for nursery production of selected herbaceous perennials and conifer seedlings. Results are presented for Ajuga, Vinca, Daylily, Frasier Fir, and White Pine.

Herbaceous Perennials

In this project field studies were developed to compare the effectiveness of methyl bromide with several alternative herbicide and fungicide combinations. Partial budgeting and a net revenue analysis are used to compare the use of methyl bromide with an alternative

herbicide and fungicide combination identified through field trials. In consultation with other experts in the project a single treatment, Subdue Maxx 21.3 SC plus a 2 inch layer of compost and treatment with Rootshield T-22, was identified as the most promising alternative to methyl bromide. Grower cost of production was calculated for this alternative. Scenario analysis was then used along with these partial budgeting results to highlight some of the potential impacts of adopting an alternative practice.

The scenarios analyzed for the treatment and each plant type were: no change in yield or price, five percent decrease in yield, ten percent decrease in yield, a change in relative plant quality and production loss. Specifically, after speaking with extension experts and growers it was assumed that base yields for Daylily and Ajuga were as follows: 40 percent of yield were #1 plants, 30 percent were #2, and 30 percent were not saleable. In the case of Vinca, 40 percent were #1 while the remaining 60 percent were a loss, since there is generally no market for #2 Vincas. In one scenario yields of Daylily and Ajuga were adjusted in terms of quality as follows: 20 percent were #1, 30 percent were #2, and 50 percent were not saleable (again, only #1 Vincas were used to calculate net revenue). In the analysis, all of the alternative scenarios occurred independently.

Results of the analysis are given in the tables below and are reported in terms of changes in net revenue (per acre) from the conventional scenario of production of herbaceous perennials using methyl bromide. For all plant types and treatments there are negative changes in net revenue when we assume no change in output price or yield. Impacts are greatest in the scenario where we assume a different mix of yield qualities. A reasonable conclusion is that the effect on output (quality and/or quantity) will determine economic impact for individual growers who switch from methyl bromide to the alternatives identified,

rather than the more direct and immediate adjustments to material costs. More research is needed on the measurable impacts on plant quality of methyl bromide alternatives in herbaceous perennials.

Table 2. Change in Net Revenue with Subdue Maxx 21.3 SC plus Compost 2" and Fall Rootshield T-22 versus Methyl Bromide

	No change in yield	5% less yield*	10% lower yield*	20-30-50 yield quality mix
Ajuga	-$478.50	-$1,303.50	-$2,128.50	-$6,478.50
Vinca	-$96.50	-$2,910.50	-$5,724.50	-$28,236.50
Day Lily	-$846.50	-$1,602.75	-$2,359.00	-$6,346.50

* yields of both #1 and #2 plants are reduced

Conifer Seedlings

Production of Frasier Fir seedlings and transplants (3-0 and 2+2), and White Pine seedlings (2-0) with and without Methyl Bromide was analyzed for this portion of the project. In consultation with other experts in the project, treatments 1(Sureguard), 4 (Goal), and 6 (Goal + P. Magnum) were chosen as the best alternatives to methyl bromide. Adjustments to grower cost of production were calculated for each of these alternatives. Scenario analysis was then used along with these partial budgeting results to highlight some of the potential impacts of adopting an alternative practice. The scenarios analyzed for each treatment and each plant type were: no change in yield or price, a five percent decrease in yield, a five percent decrease in price, a ten percent decrease in yield, and a ten percent decrease in price. In the analysis all of the alternative scenarios occurred independently.

Results of the analysis are given in the tables below and are reported in terms of changes in net revenue (per acre) from the conventional scenario of production of conifer seedlings using methyl bromide. For all plant types and treatments there are positive changes in net revenue when we assume no change in output price or seedling yield. However, net revenue quickly becomes negative and in some cases substantially reduced if the alternative

treatments were to result in 10 percent lower yields or output prices (from lower quality plants). A reasonable conclusion is that the effect on output (quality and/or quantity) will determine economic impact for individual growers who switch from methyl bromide to the alternatives identified, rather than the more direct and immediate adjustments to material costs.

Table 3. Change in Net Revenue with Goal (Treatment 4) versus Methyl Bromide

	No Change in output price or yield	5% lower price	5% less yield	10% lower price	10% less yield
	…….$/acre…….				
Frasier Fir, 3-0	$99.85	-$7,325.15	-$7,550.15	-$15,087.65	-$14,975.15
Frasier Fir, 2+2	$77.12	-$2,802.88	-$2,814.88	-$5,706.88	-$5,706.88
White Pine, 2-0	$77.12	-$5,660.38	-$5,787.88	-$11,566.63	-$11,480.38

Table 4. Change in Net Revenue with Sureguard (Treatment 1) versus Methyl Bromide

	No Change in output price or yield	5% lower price	5% less yield	10% lower price	10% less yield
	…….$/acre…….				
Frasier Fir, 3-0	$82.45	-$7,342.55	-$7,567.55	-$15,105.05	-$14,992.55
Frasier Fir, 2+2	$65.52	-$2,814.48	-$2,826.48	-$5,718.48	-$5,718.48
White Pine, 2-0	$65.52	-$5,671.98	-$5,799.48	-$11,578.23	-$11,491.98

Table 5. Change in Net Revenue with Goal + P. Magnum (Treatment 6) versus Methyl Bromide

	No Change in output price or yield	5% lower price	5% less yield	10% lower price	10% less yield
	…….$/acre…….				
Frasier Fir, 3-0	$438.85	-$6,986.15	-$7,211.15	-$14,748.65	-$14,636.15
Frasier Fir, 2+2	$22.62	-$2,857.38	-$2,869.38	-$5,761.38	-$5,761.38
White Pine, 2-0	$303.12	-$5,434.38	-$5,561.88	-$11,340.63	-$11,254.38

References

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USDA-NASS. 2000. Michigan Rotational Survey: Nursery and Christmas Trees, 1999-2000. Michigan Department of Agriculture, USDA-NASS. http://www.nass.usda.~gov/Statistics_by_State/Michigan/Publications/Michigan_Rotation~al_Surveys/index.asp

USDA-NASS. 2005. Michigan Rotational Survey: Nursery and Christmas Trees, 2004-2005. http://www.nass.usda.gov/Statistics_by_State/Michigan/Publications/~Michigan_Rotational_Surveys/index.asp

Appendix I

Selected Publications

Suzanne Thornsbury and Tracy Beedy. “Economic Report,” Methyl Bromide Task Force, Grand Rapids, MI January 11, 2006.

Cristobal Aguilar and Suzanne Thornsbury. “Research Evaluation and Outreach for Methyl Bromide Alternatives in Conifer Seedlings,” Michigan Seedling Growers Annual Meeting. Fremont, MI August 30, 2005.

Suzanne Thornsbury and Cristobal Aquilar. “Conifer Seedling Data Collection Plans for 2005.” Michigan Seedling Economic Committee. Fremont, MI February 9, 2005.

Suzanne Thornsbury and Cristobal Aquilar. “Methyl Bromide Economic Update,” MI Methyl Bromide Advisory Committee meeting. Grand Rapids, MI January 12, 2005.

Cristobal Aguilar and Suzanne Thornsbury. “Research Evaluations and Outreach for Methyl Bromide Alternatives in Conifer Seedlings,” Michigan Seedling Association Annual Meeting. Fennville, MI September 17, 2004.

Appendix II

Partial budgets: conifer seedlings

Partial Budget for Fraser Fir Seedlings, 3 year cycle

Base and comparative budget ($/acre/cycle)				
Costs:	M. bromide	A	B	C
fumigation	$1,900.00	$0.00	$0.00	$0.00
herbicide	$119.25	$159.00	$176.40	$279.00
fungicide*	$107.94	$1,868.34	$1,868.34	$1,868.34
cultivate rows	$1,035.36	$1,035.36	$1,035.36	$1,035.36
hand-weeding	$3,060.00	$3,060.00	$3,060.00	$2,601.00
Partial costs	**$6,222.55**	**$6,122.70**	**$6,140.10**	**$5,783.70**
Returns:	M. bromide	A	B	C
Marketable yield (1000)	675	675	675	675.0
Market price (1000)	$225.00	$225.00	$225.00	$225.00
Gross Revenue	**$151,875.00**	**$151,875.00**	**$151,875.00**	**$151,875.00**
Change in revenue		$0.00	0.00	0.00
Changes in Costs		-$99.85	-$82.45	-$438.85
Change in Net Returns		**$99.85**	**$82.45**	**$438.85**

*All costs are for 2006-07 season except fungicides which are from 2005

A = Goal B = Sureguard C = Goal + P. Magnum**

**recommended for control of large crabgrass

Partial Budget for White Pine Seedlings, 2 year cycle

Base and comparative budget ($/acre/cycle)				
Costs:	M. bromide	A	B	C
fumigation	$1,900.00	$0.00	$0.00	$0.00
herbicide	$79.50	$106.00	$117.60	$186.00
fungicide*	$71.96	$1,868.34	$1,868.34	$1,868.34
cultivate rows	$690.24	$690.24	$690.24	$690.24
hand-weeding	$2,040.00	$2,040.00	$2,040.00	$1,734.00
Partial costs	**$4,781.70**	**$4,704.58**	**$4,716.18**	**$4,478.58**
Returns:	M. bromide	A	B	C
Marketable yield (1000)	675	675	675	675
Market price (1000)	$172.50	$172.50	$172.50	$172.50
Gross Revenue	**$116,437.50**	**$116,437.50**	**$116,437.50**	**$116,437.50**
Change in revenue		$0.00	$0.00	$0.00
Changes in Costs		-$77.12	-$65.52	-$303.12
Change in Net Returns		**$77.12**	**$65.52**	**$303.12**

*All costs are for 2006-07 season except fungicides which are from 2005

A = Goal B = Sureguard C = Goal + P. Magnum**

**recommended for control of large crabgrass

Partial Budget for Fraser Fir Transplants, two years

Base and comparative budget ($/acre/cycle)				
Costs:	M. bromide	A	B	C
fumigation	$1,900.00	$0.00	$0.00	$0.00
herbicide	$79.50	$106.00	$117.60	$186.00
fungicide*	$71.96	$1,868.34	$1,868.34	$1,868.34
cultivate rows	$230.00	$230.00	$230.00	$230.00
hand-weeding	$170.00	$170.00	$170.00	$144.50
Partial costs	**$2,451.46**	**$2,374.34**	**$2,385.94**	**$2,428.84**
Total Returns:	M. bromide	A	B	C
Marketable yield (1000)	80	80	80	80
Market price (1000)	$723.00	$723.00	$723.00	$723.00
Gross Revenue	**$57,840.00**	**$57,840.00**	**$57,840.00**	**$57,840.00**
Change in revenue		$0.00	$0.00	$0.00
Changes in Costs		-$77.12	-$65.52	-$22.62
Change in Net Returns		**$77.12**	**$65.52**	**$22.62**

*All costs are for 2006-07 season except fungicides which are from 2005

A = Goal B = Sureguard C = Goal + P. Magnum**

**recommended for control of large crabgrass

Partial Budget for Fraser Fir Seedlings, 3 year cycle with 5% price reduction

Base and comparative budget ($/acre/cycle)*				
Costs:	M. bromide	A	B	C
fumigation	$1,900.00	$0.00	$0.00	$0.00
herbicide	$119.25	$159.00	$176.40	$279.00
fungicide	$107.94	$1,868.34	$1,868.34	$1,868.34
cultivate rows	$1,035.36	$1,035.36	$1,035.36	$1,035.36
hand-weeding	$3,060.00	$3,060.00	$3,060.00	$2,601.00
Partial costs	**$6,222.55**	**$6,122.70**	**$6,140.10**	**$5,783.70**
Returns:	M. bromide	A	B	C
Marketable yield (1000)	675	675	675	675
Market price (1000)	$225.00	$214.00	$214.00	$214.00
	$151,875.0	**$144,450.0**	**$144,450.0**	**$144,450.0**
Gross Revenue	**0**	**0**	**0**	**0**
Change in revenue		-$7,425.00	-$7,425.00	-$7,425.00
Changes in Costs		-$99.85	-$82.45	-$438.85
Change in Net Returns		**-$7,325.15**	**-$7,342.55**	**-$6,986.15**

*All costs are for 2006-07 season except fungicides which are from 2005

A = Goal B = Sureguard C = Goal + P. Magnum**

**recommended for control of large crabgrass

Partial Budget for White Pine Seedlings, 2 year cycle with 5% price reduction

Base and comparative budget ($/acre/cycle)				
Costs:	M. bromide	A	B	C
fumigation	$1,900.00	$0.00	$0.00	$0.00
herbicide	$79.50	$106.00	$117.60	$186.00
fungicide*	$71.96	$1,868.34	$1,868.34	$1,868.34
cultivate rows	$690.24	$690.24	$690.24	$690.24
hand-weeding	$2,040.00	$2,040.00	$2,040.00	$1,734.00
Partial costs	**$4,781.70**	**$4,704.58**	**$4,716.18**	**$4,478.58**
Returns:	M. bromide	A	B	C
Marketable yield (1000)	675	675	675	675
Market price (1000)	$172.50	$164.00	$164.00	$164.00
Gross Revenue	**$116,437.50**	**$110,700.00**	**$110,700.00**	**$110,700.00**
Change in revenue		-$5,737.50	-$5,737.50	-$5,737.50
Changes in Costs		-$77.12	-$65.52	-$303.12
Change in Net Returns		**-$5,660.38**	**-$5,671.98**	**-$5,434.38**

*All costs are for 2006-07 season except fungicides which are from 2005

A = Goal B = Sureguard C = Goal + P. Magnum**

**recommended for control of large crabgrass

Partial Budget for Fraser Fir Transplants, two years with 5% price reduction

Base and comparative budget ($/acre/cycle)				
Costs:	M. bromide	A	B	C
fumigation	$1,900.00	$0.00	$0.00	$0.00
herbicide	$79.50	$106.00	$117.60	$186.00
fungicide*	$71.96	$1,868.34	$1,868.34	$1,868.34
cultivate rows	$230.00	$230.00	$230.00	$230.00
hand-weeding	$170.00	$170.00	$170.00	$144.50
Partial costs	**$2,451.46**	**$2,374.34**	**$2,385.94**	**$2,428.84**
Total Returns:	M. bromide	A	B	C
Marketable yield (1000)	80	80	80	80
Market price (1000)	$723.00	$687.00	$687.00	$687.00
Gross Revenue	**$57,840.00**	**$54,960.00**	**$54,960.00**	**$54,960.00**
Change in revenue		-$2,880.00	-$2,880.00	-$2,880.00
Changes in Costs		-$77.12	-$65.52	-$22.62
Change in Net Returns		**-$2,802.88**	**-$2,814.48**	**-$2,857.38**

*All costs are for 2006-07 season except fungicides which are from 2005

A = Goal B = Sureguard C = Goal + P. Magnum**

**recommended for control of large crabgrass

Partial Budget for Fraser Fir Seedlings, 3 year cycle with 10% price reduction

Base and comparative budget ($/acre/cycle)				
Costs:	M. bromide	A	B	C
fumigation	$1,900.00	$0.00	$0.00	$0.00
herbicide	$119.25	$159.00	$176.40	$279.00
fungicide*	$107.94	$1,868.34	$1,868.34	$1,868.34
cultivate rows	$1,035.36	$1,035.36	$1,035.36	$1,035.36
hand-weeding	$3,060.00	$3,060.00	$3,060.00	$2,601.00
Partial costs	**$6,222.55**	**$6,122.70**	**$6,140.10**	**$5,783.70**
Returns:	M. bromide	A	B	C
Marketable yield (1000)	675	675	675	675
Market price (1000)	$225.00	$202.50	$202.50	$202.50
Gross Revenue	**$151,875.00**	**$136,687.50**	**$136,687.50**	**$136,687.50**
Change in revenue		-$15,187.50	-$15,187.50	-$15,187.50
Changes in Costs		-$99.85	-$82.45	-$438.85
Change in Net Returns		**-$15,087.65**	**-$15,105.05**	**-$14,748.65**

*All costs are for 2006-07 season except fungicides which are from 2005

A = Goal B = Sureguard C = Goal + P. Magnum**

**recommended for control of large crabgrass

Partial Budget for White Pine Seedlings, 2 year cycle with 10% price reduction

Base and comparative budget ($/acre/cycle)				
Costs:	M. bromide	A	B	C
fumigation	$1,900.00	$0.00	$0.00	$0.00
herbicide	$79.50	$106.00	$117.60	$186.00
fungicide*	$71.96	$1,868.34	$1,868.34	$1,868.34
cultivate rows	$690.24	$690.24	$690.24	$690.24
hand-weeding	$2,040.00	$2,040.00	$2,040.00	$1,734.00
Partial costs	**$4,781.70**	**$4,704.58**	**$4,716.18**	**$4,478.58**
Returns:	M. bromide	A	B	C
Marketable yield (1000)	675	675	675	675
Market price (1000)	$172.50	$155.25	$155.25	$155.25
Gross Revenue	**$116,437.50**	**$104,793.75**	**$104,793.75**	**$104,793.75**
Change in revenue		-$11,643.75	-$11,643.75	-$11,643.75
Changes in Costs		-$77.12	-$65.52	-$303.12
Change in Net Returns		**-$11,566.63**	**-$11,578.23**	**-$11,340.63**

*All costs are for 2006-07 season except fungicides which are from 2005

A = Goal B = Sureguard C = Goal + P. Magnum**

**recommended for control of large crabgrass

Partial Budget for Fraser Fir Transplants, 2 years with 10% price reduction

Base and comparative budget ($/acre/cycle)				
Costs:	M. bromide	A	B	C
fumigation	$1,900.00	$0.00	$0.00	$0.00
herbicide	$79.50	$106.00	$117.60	$186.00
fungicide*	$71.96	$1,868.34	$1,868.34	$1,868.34
cultivate rows	$230.00	$230.00	$230.00	$230.00
hand-weeding	$170.00	$170.00	$170.00	$144.50
Partial costs	**$2,451.46**	**$2,374.34**	**$2,385.94**	**$2,428.84**
Total Returns:	M. bromide	A	B	C
Marketable yield (1000)	80	80	80	80
Market price (1000)	$723.00	$650.70	$650.70	$650.70
Gross Revenue	**$57,840.00**	**$52,056.00**	**$52,056.00**	**$52,056.00**
Change in revenue		-$5,784.00	-$5,784.00	-$5,784.00
Changes in Costs		-$77.12	-$65.52	-$22.62
Change in Net Returns		**-$5,706.88**	**-$5,718.48**	**-$5,761.38**

*All costs are for 2006-07 season except fungicides which are from 2005

A = Goal B = Sureguard C = Goal + P. Magnum**

**recommended for control of large crabgrass

Partial Budget for Fraser Fir Seedlings, 3 year cycle with 5% yield reduction

Base and comparative budget ($/acre/cycle)				
Costs:	M. bromide	A	B	C
fumigation	$1,900.00	$0.00	$0.00	$0.00
herbicide	$119.25	$159.00	$176.40	$279.00
fungicide*	$107.94	$1,868.34	$1,868.34	$1,868.34
cultivate rows	$1,035.36	$1,035.36	$1,035.36	$1,035.36
hand-weeding	$3,060.00	$3,060.00	$3,060.00	$2,601.00
Partial costs	**$6,222.55**	**$6,122.70**	**$6,140.10**	**$5,783.70**
Returns:	M. bromide	A	B	C
Marketable yield (1000)	675	641	641	641
Market price (1000)	$225.00	$225.00	$225.00	$225.00
Gross Revenue	**$151,875.00**	**$144,225.00**	**$144,225.00**	**$144,225.00**
Change in revenue		-$7,650.00	-7,650.00	-7,650.00
Changes in Costs		-$99.85	-$82.45	-$438.85
Change in Net Returns		**-$7,550.15**	**-$7,567.55**	**-$7,211.15**

*All costs are for 2006-07 season except fungicides which are from 2005

A = Goal B = Sureguard C = Goal + P. Magnum**

**recommended for control of large crabgrass

Partial Budget for White Pine Seedlings, 2 year cycle with 5% yield reduction

Base and comparative budget ($/acre/cycle)				
Costs:	M. bromide	A	B	C
fumigation	$1,900.00	$0.00	$0.00	$0.00
herbicide	$79.50	$106.00	$117.60	$186.00
fungicide*	$71.96	$1,868.34	$1,868.34	$1,868.34
cultivate rows	$690.24	$690.24	$690.24	$690.24
hand-weeding	$2,040.00	$2,040.00	$2,040.00	$1,734.00
Partial costs	**$4,781.70**	**$4,704.58**	**$4,716.18**	**$4,478.58**
Returns:	M. bromide	A	B	C
Marketable yield (1000)	675	641	641	641
Market price (1000)	$172.50	$172.50	$172.50	$172.50
Gross Revenue	**$116,437.50**	**$110,572.50**	**$110,572.50**	**$110,572.50**
Change in revenue		-$5,865.00	-$5,865.00	-$5,865.00
Changes in Costs		-$77.12	-$65.52	-$303.12
Change in Net Returns		**-$5,787.88**	**-$5,799.48**	**-$5,561.88**

*All costs are for 2006-07 season except fungicides which are from 2005

A = Goal B = Sureguard C = Goal + P. Magnum**

**recommended for control of large crabgrass

Partial Budget for Fraser Fir Transplants, two years with 5% yield reduction

Base and comparative budget ($/acre/cycle)				
Costs:	M. bromide	A	B	C
fumigation	$1,900.00	$0.00	$0.00	$0.00
herbicide	$79.50	$106.00	$117.60	$186.00
fungicide*	$71.96	$1,868.34	$1,868.34	$1,868.34
cultivate rows	$230.00	$230.00	$230.00	$230.00
hand-weeding	$170.00	$170.00	$170.00	$144.50
Partial costs	**$2,451.46**	**$2,374.34**	**$2,385.94**	**$2,428.84**
Total Returns:	M. bromide	A	B	C
Marketable yield (1000)	80	76	76	76
Market price (1000)	$723.00	$723.00	$723.00	$723.00
Gross Revenue	**$57,840.00**	**$54,948.00**	**$54,948.00**	**$54,948.00**
Change in revenue		-$2,892.00	-$2,892.00	-$2,892.00
Changes in Costs		-$77.12	-$65.52	-$22.62
Change in Net Returns		**-$2,814.88**	**-$2,826.48**	**-$2,869.38**

*All costs are for 2006-07 season except fungicides which are from 2005

A = Goal B = Sureguard C = Goal + P. Magnum**

**recommended for control of large crabgrass

Partial Budget for Fraser Fir Seedlings, 3 year cycle with 10% yield reduction

Base and comparative budget ($/acre/cycle)				
Costs:	M. bromide	A	B	C
fumigation	$1,900.00	$0.00	$0.00	$0.00
herbicide	$119.25	$159.00	$176.40	$279.00
fungicide*	$107.94	$1,868.34	$1,868.34	$1,868.34
cultivate rows	$1,035.36	$1,035.36	$1,035.36	$1,035.36
hand-weeding	$3,060.00	$3,060.00	$3,060.00	$2,601.00
Partial costs	**$6,222.55**	**$6,122.70**	**$6,140.10**	**$5,783.70**
Returns:	M. bromide	A	B	C
Marketable yield (1000)	675	608	608	608
Market price (1000)	$225.00	$225.00	$225.00	$225.00
Gross Revenue	**$151,875.00**	**$136,800.00**	**$136,800.00**	**$136,800.00**
Change in revenue		-$15,075.00	-$15,075.00	-$15,075.00
Changes in Costs		-$99.85	-$82.45	-$438.85
Change in Net Returns		**-$14,975.15**	**-$14,992.55**	**-$14,636.15**

*All costs are for 2006-07 season except fungicides which are from 2005

A = Goal B = Sureguard C = Goal + P. Magnum**

**recommended for control of large crabgrass

Partial Budget for White Pine Seedlings, 2 year cycle with 10% yield reduction

Base and comparative budget ($/acre/cycle)				
Costs:	M. bromide	A	B	C
fumigation	$1,900.00	$0.00	$0.00	$0.00
herbicide	$79.50	$106.00	$117.60	$186.00
fungicide*	$71.96	$1,868.34	$1,868.34	$1,868.34
cultivate rows	$690.24	$690.24	$690.24	$690.24
hand-weeding	$2,040.00	$2,040.00	$2,040.00	$1,734.00
Partial costs	**$4,781.70**	**$4,704.58**	**$4,716.18**	**$4,478.58**
Returns:	M. bromide	A	B	C
Marketable yield (1000)	675	608	608	608
Market price (1000)	$172.50	$172.50	$172.50	$172.50
Gross Revenue	**$116,437.50**	**$104,880.00**	**$104,880.00**	**$104,880.00**
Change in revenue		-$11,557.50	-$11,557.50	-$11,557.50
Changes in Costs		-$77.12	-$65.52	-$303.12
Change in Net Returns		**-$11,480.38**	**-$11,491.98**	**-$11,254.38**

*All costs are for 2006-07 season except fungicides which are from 2005

A = Goal B = Sureguard C = Goal + P. Magnum**

**recommended for control of large crabgrass

Partial Budget for Fraser Fir Transplants, two years with 10% yield reduction

Base and comparative budget ($/acre/cycle)				
Costs:	M. bromide	A	B	C
fumigation	$1,900.00	$0.00	$0.00	$0.00
herbicide	$79.50	$106.00	$117.60	$186.00
fungicide*	$71.96	$1,868.34	$1,868.34	$1,868.34
cultivate rows	$230.00	$230.00	$230.00	$230.00
hand-weeding	$170.00	$170.00	$170.00	$144.50
Partial costs	**$2,451.46**	**$2,374.34**	**$2,385.94**	**$2,428.84**
Total Returns:	M. bromide	A	B	C
Marketable yield (1000)	80	72	72	72
Market price (1000)	$723.00	$723.00	$723.00	$723.00
Gross Revenue	**$57,840.00**	**$52,056.00**	**$52,056.00**	**$52,056.00**
Change in revenue		-$5,784.00	-$5,784.00	-$5,784.00
Changes in Costs		-$77.12	-$65.52	-$22.62
Change in Net Returns		**-$5,706.88**	**-$5,718.48**	**-$5,761.38**

*All costs are for 2006-07 season except fungicides which are from 2005

A = Goal B = Sureguard C = Goal + P. Magnum**

**recommended for control of large crabgrass

Appendix III

Partial budgets: herbaceous perennials

Partial Budget for Ajuga, 1 year, seeded					
Costs:	$/acre/cycle with MB	$/acre/cycle: No MB	$/acre/cycle: No MB, 5% lower yield	$/acre/cycle: No MB, 10% lower yield	$/acre/cycle: No MB, 20-30-50 Quality Mix
fumigation	$1,900	$0	$0	$0	$0
herbicide (material)	$12	$106	$106	$106	$106
fungicide (material)	$356	$153	$153	$153	$153
soil amendments-compost	$0	$2,488	$2,488	$2,488	$2,488
subtotals	$2,268	$2,747	$2,747	$2,747	$2,747
Returns:	$/acre/cycle with MB	$/acre/cycle W/O MB	$/acre/cycle: No MB, 5% lower yield	$/acre/cycle: No MB, 10% lower yield	$/acre/cycle: No MB, 20-30-50 Quality Mix
Marketable yield (1000) #1	12.00	12.00	11.40	10.8	6.00
Market price (1000) #1	$1,000.00	$1,000.00	$1,000.00	$1,000.00	$1,000.00
Marketable yield (1000) liners	9	9	8.55	8.1	9
Market price (1000) liners	$500.00	$500.00	$500.00	$500.00	$500.00
Gross Revenue	$16,500.00	$16,500.00	$15,675.00	$14,850.00	$10,500.00
Net Changes:	$/acre/cycle with MB	$/acre/cycle W/O MB	$/acre/cycle: No MB, 5% lower yield	$/acre/cycle: No MB, 10% lower yield	$/acre/cycle: No MB, 20-30-50 Quality Mix
Change in revenue	$0.00	$0.00	-$825.00	-$1,650.00	-$6,000.00
Changes in Costs	$0.00	$478.50	$478.50	$478.50	$478.50
Change in Net Returns	$0.00	-$478.50	-$1,303.50	-$2,128.50	-$6,478.50

Partial Budget for Vinca

Costs:	$/acre/cycle with MB	$/acre/cycle W/O MB	$/acre/cycle: No MB, 5% lower yield	$/acre/cycle: No MB, 10% lower yield	$/acre/cycle: No MB, 20-30-50 Quality Mix
fumigation	$1,900	$0	$0	$0	$0
herbicide application	$0	$106	$106	$106	$106
fungicide application	$750	$153	$153	$153	$153
soil amendments-compost	$0	$2,488	$2,488	$2,488	$2,488
subtotals	$2,650	$2,747	$2,747	$2,747	$2,747

Returns:	$/acre/cycle with MB	$/acre/cycle W/O MB	$/acre/cycle: No MB, 5% lower yield	$/acre/cycle: No MB, 10% lower yield	$/acre/cycle: No MB, 20-30-50 Quality Mix
Marketable yield (1000) #1	84.00	84.00	79.8	75.6	42
Market price (1000) #1	$670.00	$670.00	$670.00	$670.00	$670.00
Gross Revenue	$56,280.00	$56,280.00	$53,466.00	$50,652.00	$28,140.00

Net Changes:	$/acre/cycle with MB	$/acre/cycle W/O MB	$/acre/cycle: No MB, 5% lower yield	$/acre/cycle: No MB, 10% lower yield	$/acre/cycle: No MB, 20-30-50 Quality Mix
Change in revenue	$0.00	$0.00	-$2,814.00	-$5,628.00	-$28,140.00
Changes in Costs	$0.00	$96.50	$96.50	$96.50	$96.50
Change in Net Returns	$0.00	-$96.50	-$2,910.50	-$5,724.50	-$28,236.50

Partial Budget for Day Lily

Costs:	$/acre/cycle with MB	$/acre/cycle W/O MB	$/acre/cycle: No MB, 5% lower yield	$/acre/cycle: No MB, 10% lower yield	$/acre/cycle: No MB, 20-30-50 Quality Mix
fumigation	$1,900	$0	$0	$0	$0
herbicide application	$0	$106	$106	$106	$106
fungicide application	$0	$153	$153	$153	$153
soil amendments-compost	$0	$2,488	$2,488	$2,488	$2,488
subtotals	$1,900	$2,747	$2,747	$2,747	$2,747

Returns:	$/acre/cycle with MB	$/acre/cycle W/O MB	$/acre/cycle: No MB, 5% lower yield	$/acre/cycle: No MB, 10% lower yield	$/acre/cycle: No MB, 20-30-50 Quality Mix
Marketable yield (1000) #1	22.00	22.00	20.90	19.8	11
Market price (1000) #1	$500.00	$500.00	$500.00	$500.00	$500.00
Marketable yield (1000) liners	16.5	16.5	15.68	14.85	16.5
Market price (1000) liners	$250.00	$250.00	$250.00	$250.00	$250.00
Gross Revenue	$15,125.00	$15,125.00	$14,368.75	$13,612.50	$9,625.00

Net Changes:	$/acre/cycle with MB	$/acre/cycle W/O MB	$/acre/cycle: No MB, 5% lower yield	$/acre/cycle: No MB, 10% lower yield	$/acre/cycle: No MB, 20-30-50 Quality Mix
Change in revenue	$0.00	$0.00	-$756.25	-$1,512.50	-$5,500.00
Changes in Costs	$0.00	$846.50	$846.50	$846.50	$846.50
Change in Net Returns	$0.00	-$846.50	-$1,602.75	-$2,359.00	-$6,346.50